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BIOGRAPHY.

LOBACHEVSKY.

BY DR. GEORGE BRUCE HALSTED.

NICOLAI IVANOVICH LOBACHEVSKY was born November 3, 1793, which, according to the old style calender still used in Russia, is there written October 22, 1793. His father was an architect. This is explicitly stated in the edition of Lobachevsky's works published by the Imperial University of Kasan, so that C. S. Peirce is wrong when in his review of my translation of Vasiliev's Address on Lobachevsky, in the Nation of April 4th, 1895, he criticises Ch. Rumelin for this statement. Rumelin is right. Lobachevsky was born in the town of Makariev about 40 miles above Nizhni-Novgorod on the Volga.

His father died in 1797, and his mother soon after removed to Kasan, where she succeeded in getting her two sons admitted free to the Gymnasium. Lobachevsky entered in November 1802. On February 14th, 1807, after standing his examination, he was admitted as a free student to the University of Kasan, the statutes creating which had only been signed November 5th, 1804. Lobachevsky's wildness, disobedience and contempt for orders drew down upon him the severe disapproval of the University authorities; once he was threatened with exclusion from the University, and it was only due to the protection of Bartels, the professor of mathematics, that he was permitted to finish his course.

Toward Bartels Lobachevsky retained to the end of his life the keenest feeling of regard and gratitude.

He studied practical astronomy with Littrow, under whose direction he made observations on the comet of 1811. July 10th, 1811 he received the



NICOLAI IVANOVICH LOBACHEVSKY.

master's degree, and then began teaching as assistant to Bartels. In 1814 he was made adjunct professor of mathematics, and in 1816. full professor. On May 3rd, 1827, when only 33 years old, he was made Rector, and occupied during 19 years the first place in the University of Kasan. In 1846 he was appointed assistant Curator of the district of Kasan, and went to live in a village which belonged to him, Belovoljskaya Slobodka, sixty versts from Kasan up the Volga, where the forest of nut trees planted by him still remains. Toward the end of his life he became blind, but continued his scientific activity and his complete conviction of the profound importance of his non Euclidean geometry. His last work "Pangeometrie" was produced after his blindness. In 1856 he died.

The researches of Lobachevsky on the systematic interpretation of geometry began before 1823, for in that year he presented to Magnetsky, then Rector, with the idea of having it printed at the charge of the crown, a manual of geometry, written in the "classic" form.

It is a great pity that this most interesting manuscript is lost. From the detailed judgement of Fus on it we cannot gather that Lobachevsky expressed in this manual any original views on the theory of parallels. This point will be of still greater interest in the future, for I am at present engaged in translating from the Hungarian or Magyar language important documents recently obtained in regard to the two Bolyais, and with them a letter, hitherto unknown and not even yet published, from John Bolyai, the scientific twin of Lobachevsky, in which he announces to his father in 1823 the discovery of the non-Euclidean geometry.

Though Lobachevsky's "Geometric Researches on the Theory of Parallels," published in 1840, of which my English translation is now in its fourth edition and has been beautifully reproduced in Japan, remains even today the simplest introduction to the subject which has ever appeared; yet in it Lobachevsky has not reached that final breadth of view given first in John Bolyai's "Science Absolute of Space," but also attained in Lobachevsky's last work *Pangeometrie*, which name he explicitly uses as expressive of this final view.

There is one point, incomprehensible to his contemporaries, which we can appreciate now as showing the marvellous precision and keenness of Lobachevsky's logic and mathematical perception.

As early as 1834 he made the distinction in regard to functions, which nearly half a century later Weierstrass and P. du Bois-Reymond forced upon the attention of the mathematical world, namely the distinction between continuity and differentiability. Lobachevsky said, "The function is 'postepennost' [what we now call *continuous*] when the increment in it is diminished to zero together with the increment of the variable x . The function is 'neprerivnost' [what we now call *differentiable*] when the ratio of these two increments, as they diminish, goes over insensibly into a new function, that will be, consequently, a differential co-efficient." C. S. Peirce says of this, "Who in Russia in 1834 could possibly see any sense in the contention of Lobachevsky that it

was one thing for a curved line to be continuous, and quite another for it to have definite tangents? The mathematicians of Western Europe did not become aware of the distinction until nearly 1880, when Weierstrass suggested that a line might be wavy, and these waves carry smaller waves, and those still smaller waves, and so on *ad infinitum*. Down to this day there is but one text-book on the differential Calculus (that of Camille Jordan, in its second edition) which introduces the distinction. All of Lobachevsky's writings are marked by the same high-strung logic."

The solar corona, one of the most remarkable phenomena in nature, was not enough noticed to receive a name until 1851. But it was carefully observed by Lobachevsky at the eclipse of July 8, 1842, and by him minutely described. These things are mentioned to show that Lobachevsky was a modern scientists of the very soundest sort, whose only misfortune was to be half-a-century ahead of the world. But as soon as the world reached him it did ample justice to his influence and his memory. In my Bibliography of non-Euclidean Geometry in the American Journal of Mathematics 1878, reproduced by Vastchenko-Zacharchenko in his Introduction to the Elements of Euclid in 1880, and again reprinted in 1886 at the end of the second volume of the collected geometric works of Lobachevsky (Edition of the Imperial University of Kasan), I gave more than a hundred and seventy five works, and in less than ten years, 1887, the number had grown to over three hundred, and now is so enormously great that the task of a new edition of my Bibliography overwhelms me.

The most distinguished men of the generation just passed, Grassmann, Riemann, Helmholtz, Clifford, Cayley; the ablest of living mathematicians, Lie, Klein, Sylvester, Sir R. Ball, Poincare have won some of their choicest honors in the domain of the non-Euclidean geometry. Its day of probation is safely passed, and one might better square the circle and invent perpetual motion than make the slightest objection to the non-Euclidean geometry.

And now in bringing to a close this meagre notice of a wonderful genius, let me say that no attempt has here been made to give an intimate picture of the man himself, because that has already been done to perfection in the magnificent Address of Lobachevsky's worthy successor at Kasan, Professor A. Vasiliev. Of this L. E. Dickson, of the University of Chicago, himself a genius, speaks as follows: "From every one devoted to mathematics or philosophy, or indeed to the highest advance of human thought in any form, this address will call forth the deepest admiration for Lobachevsky, now recognized as one of the greatest intellectual revolutionizers the world has ever had. It will arouse a deeper enthusiasm for scientific achievement and widen the horizon of every reader."
